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ABSTRACT

The effectiveness of the use of self-reported imagery strategies on children's subsequent memory performance was studied, and the coding redundancy hypothesis that memory is facilitated by using an encoding procedure in both words and images was tested. The two levels of reported memory strategy (imagize, verbalize) were crossed with "think picture," "think word" and "no induced strategy" levels. A 40-item recognition test of words and pictures was the criterion measure administered to second grade students in three Phoenix schools. The main effect, induced memory strategy was statistically significant, reflecting a higher mean score for the "think word" group than for the "no induced strategy" group. Further results are discussed, including the superiority of the "think word" group over subjects who presumably encountered stimuli in both forms, calling into question the redundancy hypothesis. Although no significant differences were associated with reported strategies' effectiveness, it was indicated that most second grade level children do report using a particular memory strategy. Further study of picture stimuli on memory strategies and strategy effects at different age levels is suggested. (CM)

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CHILDREN'S MEMORY FOR WORDS UNDER SELF-REPORTED AND INDUCED IMAGERY STRATEGIES

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INTRODUCTION

Relatively little attention in imagery research has been devoted to the imagery strategy abilities or perferences of individual Ss and their effect upon memory. The major work in this area by Levin and his associates (1974) indicates that Ss can be classified on the basis of their individual abilities in a manner that will yield reliable prediction of the relative effectiveness of different imagery strategies. However, no research has been reported in which the effects of subjects' use of their own self-reported imagery strategies or preferred strategies have been investigated.

The present study was intended to yield information about the effectiveness of use of one's self-reported memory strategy. It also provided data relevant to the coding redundancy hypothesis (Paivio, 1971). According to this hypothesis, memory is facilitated by using an encoding procedure that involves processing a stimulus in both word and imagized forms, rather than in only one of these two forms. On the basis of the coding redundancy hypothesis, it would be predicted that performance of Ss who use both codes would be superior to that of Ss who process stimuli in one form only.

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* Paper presented at annual convention of the American Educational Research Association, New York City, March 19-23, 1982.

METHOD

Subjects

The subjects were 196 second graders from 10 classes in three elementary schools. All three of the schools are located in a middle-class area in suburban Phoenix.

Each subject was classified as either a verbalizer or an imagizer based on performance on a pre-experimental task. For this task, each subject individually was shown the word "sun," printed on an 11 x 14 inch card, for three seconds and was instructed to try to remember the word. Prior to viewing the word, subjects were told that they would be given a brief period of time to try to remember it. A five-second period for trying to commit the word to memory was provided after the word had been shown for the three-second period. After the five-second period, the subject was interviewed to determine the strategy used to remember the word. Subjects who reported in essence that they "thought of the word" or "thought of the picture of the word" were included in the experimental phase of the study. Individuals whose strategy was different from these and individuals whose strategy could not be determined were not included in the experimental phase of the study.

A total of 267 second graders participated in the pre-experimental phase. Based on the self-reports of these subjects, 120 were classified as verbalizers and 111 as imagizers. These subjects were chosen for the experimental phase of the study. The remaining 36 individuals, whose repsonses could not be classified under either "thought of the word" or "thought of the picture of the word," were not included in the experimental phase of the study.

The pre-experimental phase resulted in a total of 231 individuals being identified as subjects for the experiment. Absences during the experimental phase reduced the total number of subjects for the study to 196.

Stimulus Materials

Stimuli consisted of 40 words chosen from the list of concrete nouns in Paivio, Yuille, and Madigan (1968). These concrete nouns were at the AA or A frequency in the Thorndike and Lorge (1944) word list. All words chosen had been previously taught in the basic reading program completed by all subjects. Twenty-three of the 40 words were selected from among the printed words which were vocalized correctly by 90% or more of the second-grade children in the Melnick (1980) study. The additional 17 words for the study were selected on the basis of a pre-experimental phase tryout with 51 children from two second-grade classes. Each of the 17 additional words selected was read correctly by 90% or more of these 51 children.

The learning stimuli were single printed words produced in the form of 2" x 2" slides. Each slide was prepared with 1/2" letters that were applied within a 6" x 9" format on a 10" x 12" artboard. The slides were photographed using the Kodalith orthochromatic process. The size of the letters in the projected slides considerably exceeded the commonly accepted standard for legibility of print as published by Eastman Kodak Company (1974). The slides were randomly ordered.

Procedures

The two levels of self-reported memory startegy (imagize, verbalize) were crossed with three levels of induced memory strategy (think picture, think word, no induced strategy). Thus, for both the imagize and verbalize groups, there were three different memory strategies: "think picture, " "think word," and "no induced strategy." Subjects were classified into two reading levels (high, low), using the results of a criterion-referenced reading ability test developed by the local school district and previously administered at the participating schools.

The crossing of reported memory strategy (imagize, verbalize) with reading level (high, low) and the three memory strategies (think

picture, think word, no induced strategy) yielded 12 treatment groups. Subjects were blocked by reported memory strategy and reading level and randomly assigned to one of the three memory strategies. Treatments were administered by three trained experimenters who were randomly assigned to intact treatment groups containing approximately 15 subjects from across the two reading levels. Three days prior to conducting the experiments each experimenter was given a specific set of directions to rehearse. The instructions read by experimenters to their treatment groups are presented in Appendix B.

Instructions to subjects were based on wording used in previous research by the author (Filan & Sullivan, Note 1). Subjects under the "think picture" condition were given the following instructions:

> "I am going to show you some words on slides today. You should try very hard to remember each word."
>
> "Here's how to do it: First look at the word. Then when the word goes off the screen, make a picture in your mind of the object that the word stands for. Do this for each word."
>
> "After I show you the words, we are going to see how many words you can remember."

Instructions for the "think word" condition were virtually identical to those for the "think picture" condition, except that "make a picture in your mind of the object that the word stands for" was replaced by "think of the word in your mind." Instructions for the "no induced strategy" condition were the same as instructions for the other two conditions except that the "Here's how to do it" paragraph was deleted. That is, subjects were instructed to try very hard to remember each word and were told "we will see how many words you can remember," but were not given any induced memory strategy to use.

The slides were projected with an automatic advance carousel-type projector on to a screen at the front of the classroom. For all three conditons, the projector was programmed to display each slide for three seconds, followed by a three-second blank screen so subjects could apply their memory strategy. The time periods were derived on the basis of previous research (Sullivan & Filan, Note 2).

Immediately prior to showing of the 40 experimental items, each group of subjects was given practice in their particular memory strategy through the use of four examples items. After four pre-selected slides (slides 5, 15, 25, and 35) in the 40-item sequence, experimenters made a brief comment such as "Are you making a picture of the word in your mind?" or "Try hard to remember each word." The comments were intended to remind subjects of the strategy they were to use and to keep their attention focused on the task. A one-minute rest break, during which subjects remained in their seats without talking, was given after slide 20.

Criterion Test

The criterion instrument was a recognition test composed of 40 multiple-choice items--20 word items and 20 picture items. Each item consisted of a correct choice (the word from the presentation phase or its corresponding picture) and two distractors. Thus, subjects responded to 20 items that were in the same mode on the test as they were in the presentation phase (i.e., words) and to 20 items that were given in the opposite mode (pictures). Several practice items were given prior to the criterion test in order to help subjects learn the testing procedure.

The test was constructed in two forms--one in which the 20 randomly ordered word items preceded the 20 randomly ordered pictured items, and a second in which the word-picture form and sequence were reversed. Test forms were counterbalanced within treatment conditions. The words constituting the test items were reviewed for

readability by the four second-grade teachers. The teachers judged all words to be readable by the children in their classes. The K-R 20 reliability coefficients for the tests were .84 for Form 1 and .71 for Form 2.

The criterion test was administered immediately following a two-minute break at the end of the presentation phase.

Design and Data Analysis

A completely randomized block design with three between-subjects variables (reported memory strategy, reading level, induced memory strategy) and two criterion variables (picture test mode and word test mode) was used.

The primary data analysis was a 2 x 2 x 3 univariate and multivariate analysis of variance with two criterion variables--scores on both the picture and word tests.

RESULTS

The mean scores on the criterion test are summarized by reported and induced strategy, reading level, and test mode in Table 1. The summary table for the univariate and multivariate ANOVA is presented in Table 2.

Results are discussed below by treatment and criterion factors.

Main Effect Comparisons and Interactions

The most prominent difference associated with the main-effect variables or with interactions was related to induced memory strategy. Mean scores on the 40-item criterion test for this variable were 32.50

for the "think word" group, 31.01 for the "think picture" group, and 29.52 for the "no induced strategy" group. The multivariate analysis of variance (Table 2) revealed a statistically significant effect for induced memory strategy, $F(2,184) = 2.65$, $p < .05$. Tukey's Honestly Significant Difference Test for differences between groups indicated that the mean score of 32.50 for the "think word" group was significantly higher than the mean of 29.52 for the no strategy group at a $p < .05$ level of signifiance. The differences in mean scores between the "think word" and "think picture" groups and between the "think picture" and no strategy groups were not significant. The univariate analysis yielded significant results on picture test items, $F(2,184) = 5.24$, $p < .01$, but not on word test items, $F(2,184) = 2.83$, $p < .06$.

The Tukey Honestly Significant Difference Test is designed to make all pairwise comparisons among means. This test procedure utilizes a range statistic and is an alternative to F ratio. A requirement of the Tukey test is that the sample sizes be equal. The number of subjects in each group in this study was unequal (15-18). To meet the requirement for cell size, one to three subjects per cell were randomly discarded where necessary to establish equal cell sizes.

The significant difference associated with induced memory strategy was the only significant multivariate effect obtained in the study. A significant univariate effect, as can be seen from Table 2, was obtained for reading level on picture test items only, but not for word test items. High readers attained a mean score of 15.81 on the 20 picture test items, compared to a mean of 14.95 for low readers, $F(1,184) = 4.20$, $p < .05$. The multivariate analysis revealed that the difference between the overall mean scores of 31.59 for high readers and 30.44 for low readers was not statistically significant.

No significant differences, either main effects or interactions, were obtained other than the main effect differences reported above for induced memory strategy and reading level. Under the reported

memory strategy condition, the overall mean scores of subjects who reported that they had imagized and those who reported that they had verbalized during the pre-experimenal phase were 31.05 and 30.96, respectively. Mean scores by test mode across treatments also varied only slightly--15.62 for word items and 15.39 for picture items. None of the F-ratios for interactions approached a statistically significant level.

Variance Accounted for by
Main Effect Variables
and Interactions

In addtion to the data presented in the analysis of variance source (Table 2), the variance accounted for by each variable and each interaction was computed for both word and picture test items using the method described by Krus and Krus (1978). For the word test items, induced memory strategy accounted for 3% of the total variance and no other single variable or interaction accounted for more than 1% of the total variance. The total variance accounted for by all treatment factors for word test items was only 5%. For the picture test items, induced memory strategy accounted for 2%. The total variance accounted for by all treatment factors was 11% for picture test items. Thus, the treatment effects clearly accounted for only a small proportion of the variance for both the word and the picture test sections.

Matched versus Contrasting
Memory Strategies

As shown in Table 1, there was only a slight difference in criterion test scores between the subjects in the "think word" group who were matched with their reported memory strategy (verbalize) and the subjects in the "think word" group who were not matched with their reported memory strategy (imagize). The overall mean scores on the 40-item criterion test were 32.70 for the matched "think word" group, compared to 32.30 for the unmatched "think word" group.

The overall mean score on the 40-item memory test for the "think picture" subjects who were matched with their reported memory strategy (imagize) was 31.63, as contrasted with a mean of 30.38 for the "think picture" subjects who were assigned to the condition (verbalize) that contrasted with their reported strategy. A t-test revealed that this difference was not statistically significant. Thus, there were no significant differences between subjects who were assigned to a conditon in which they were to use their self-reported memory strategy and those assigned to a condition in which they were to use the opposite strategy.

One Code versus Two Codes

The combination of factors in the factorial design resulted in the "think word" experimental groups presumably using only one mode of information processing for encoding stimuli and the "think picture" experimental groups presumably using two modes of information processing for encoding stimuli. The "think word" groups were presented with word stimuli and instructed to think of the words, whereas the "think picture" groups were presented with word stimuli and instructed to make a picture in their minds. Thus, the "think word" groups presumably encountered the stimuli only in word form, and the "think picture" groups encountered the stimuli in both word and picture form. The no strategy groups are not included in either grouping for this analysis because subjects under the no strategy condition may have used either one or two modes to encode stimuli. The overall mean scores on the 40-item memory test were 32.50 for the one code groups (see word-think word) and 31.01 for the two code groups (see word-think picture). Tukey's Honestly Significant Difference Test of mean scores for the three induced memory strategies revealed that this difference, which is in the opposite direction to what would be predicted under Paivio's dual coding hypothesis, was not statistically significant.

DISCUSSION

The present study was designed to investigate the effectiveness of children's use of self-reported imagery strategies on subsequent memory for printed word stimuli. Two levels of reported memory strategy (imagize, verbalize) were crossed with two reading levels (high, low) and three memory strategy levels (think picture, think word, no induced strategy) to comprise 12 treatment groups. The criterion measure was a 40-item three-choice recognition test comprised of 20 word items and 20 picture items. A statistically significant main effect was obtained for induced memory strategy, reflecting a significantly higher mean score on the 40-item test for the "think word" group than for the "no induced strategy" group. A significant effect was also obtained for high readers over low readers on the 20 picture test items. There were no other significant differences associated with either main effects for interactions.

The major purpose of the study was to investigate the effectiveness of children's use of their own self-reported imagery strategies on their subsequent memory performance. It seemed reasonable that children who were assigned to use the same strategy (thought of the picture or thought of the word) that they reported using on their own a pre-experimental task would perform better on the memory test than children assigned to use the strategy opposite to the one they had reported using. However, subjects assigned to an induced strategy that was matched with their reported "free-choice" strategy did not score significantly higher than subjects assigned to a strategy opposite their free-choice selction. There are at least three possible explanations for this lack of effect. One is that a subject's "preferred" strategy may be no more effective for the subject than any other strategy. A second is that the subjects' reports of the memory strategy used during the pre-experimental phase may be very unreliable--that is, many subjects may have reported that they used a

particular strategy that, in fact, they did not use. A third possible explanation is that, during the experimental phase, subjects did not actually use the strategy they were instructed to use.

The significant difference for induced memory strategy was due primarily to the difference of approximately three points in criterion test scores between the "think word" strategy groups and the "no induced strategy" groups. The "think word" groups scored approximately 1.5 points higher than the "think picture" groups and the "no induced strategy" groups, but neither of these differences was statistically significant. The finding that subjects performed less well under no given strategy is consistent with earlier results obtained by the author (Sullivan & Filan, Note 2) and others (Fleming, 1977; Pressley, 1977; Reese, 1970; Rowher, 1970), but the relative, though not statisitically significant, superiority of the think word group over the "think picture" group is not. In their 1980 study, Filan and Sullivan (Note 1) obtained a significant difference favoring "think pictures" over a "think words" as a strategy. Both words and pictures were used as stimuli in the 1970 and 1980 studies by the author, however, whereas only words were used in the present study. The use of words only as stimuli may account for the significant difference favoring the "think word" group in this study. It is possible that use of pictures as stimuli enhances the effect of the "think picture" strategy.

One might expect that subjects in the no strategy groups would employ either a verbal or an imagery strategy on their own during the experimental phase, since each of them had reported using a specific memory strategy in the pre-experimental phase of the study. Yet, if subjects in the no strategy groups actually did employ their own specific memory strategy during the experiment, why did students under an induced memory strategy out-perform them on the criterion test, as the "think word" subjects did? Perhaps when pupils were asked to report the strategy that they used, they

reported using a particular one, even though they did not use it or it was not well defined. Inducing a strategy and giving instructions in its use may result in the more explicit or conscious use of a well-defined strategy.

High readers scored significantly higher than low readers on picture test items but not on word test items. The fact that there was not a significant difference between the two groups on word test items suggests that subjects from both groups could read the words with relatively equal effectiveness. This should have been the case because all stimulus words were selected on the basis of data indicating their ease of readability, i.e., they were read aloud correctly by more than 90% of second graders in tryout groups. A possible explanation for the superior performance of high readers on picture test items is that they may be better able than low readers to make a correct transition from stimulus words to picture test items. A greater general ability factor for high readers that could produce both better reading ability and better ability to transfer across stimulus forms could conceivably account for this phenomenon.

The present study provides further data that call into question the adequacy of Paivio's (1971) coding redundancy hypothesis. According to this hypothesis, subjects who use a memory process that involves both a visual and verbal encoding system should perform better on memory tasks than individuals who use a process involving only one system. If this explanation were correct, one would expect that subjects in the "think picture" groups, who presumably used two modes of information processing for encoding stimuli, would have achieved higher mean scores than those in the "think word" groups, who presumably encountered the stimuli in word form only. Such was not the case. In fact, subjects in the "think word" groups, whose memory strategy was in one form only, actually scored 1.49 points higher overall in the criterion test than those subjects who presumably encountered each stimulus in both forms. This study and

the two earlier studies by the author have yielded data that conflict with results that would be predicted from the coding redundancy hypothesis.

Across treatments, subjects who reported using a "think word" strategy on the pre-experimental task and those who reported using a think picture strategy had very similar criterion test scores (.09 difference). That is, there was no apparent advantage associated with either of the two strategies reportedly used under a free-choice condition. Even within the "no strategy group," where subjects were free to use their own preferred strategy, there was little difference (.58 in favor of verbalizers) between the criterion test scores of imagizers and verbalizers. These small differences suggest that neither of the two self-reported strategies, to the extent that subjects actually used them, is more effective than the other when children of this age level employ them on a self-selected, non-induced basis.

Even though no significant differences were associated with children's reported memory strategies, the findings indicate that most children at the second-grade level do report using a particular memory strategy, and that approximately equal numbers report using "think word" and "think picture" strategies. Of 267 children who participated in the pre-experimental phase, 231 (87%) reported using either a verbal or a visual strategy to remember the word stimulus. A total of 120 subjects (52%) reported that they "thought of the word" and 111 (48%) reported that they "thought of the picture of the word." The fact that second-grade children are able to report using a particular memory strategy indicates that it may be possbile to use a self-report technique successfully in further research on memory strategies, despite the lack of significant differences related to self-reported strategies in this study.

At least two areas of further research related to children's reported memory strategies seem appropriate. One has to do with the use of

picture stimuli to investigate the effects of using one's preferred or self-reported strategy. Research generally indicates that children remember picture stimuli better than word stimuli (Jenkins, Neale & Deno, 1967; Perlmutter & Myers, 1976; Shepard, 1967) and that imagery is effective with picture stimuli (Kee, 1976; Levin, Bender, & Lesgold, Note 3; Levin, Rohwer, & Cleary, 1971; Paivio, 1975). Only word stimuli were used in the present study because of the complexity of the design and the numbers of subjects that would have been required if both word and picture stimuli were used. However, it is possible that the use of picture stimuli would yield different results. A second area related to the reported strategies used across age levels and to their effects at different levels. There is evidence that children's particular memory strategies are better defined and developed in upper intermediate grades than in the primary grades (Pressley, 1977; Reese, 1970; Rohwer, 1970). Whereas second graders did not perform better when an induced memory strategy was matched with their self-reported strategy, it is possible that older children would. Conceivably, older children may have a better developed personal strategy and may be able to report this preferred strategy more reliably. It would be useful to investigate both the consistency of reported preferences across age levels and the effects of using one's own strategy, particularly under induced conditions involving training in the use of the strategy, at different age levels. Research aimed at investigating such factors should be helpful in promoting our understanding of potentially effective uses of imagery as a memory strategy.

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TABLE 1

Data Format
Mean Scores by Treatment Group, Reading Level, and Test Mode

Reported Memory Strategy	Induced Memory Strategy	Reading Level and Test Mode: High Pictures	High Words	Low Pictures	Low Words	Totals Pictures	Totals Words	Grand Totals
Imagize	Think Picture	16.56	16.00	14.86	15.57	15.71	15.79	31.50
	Think Word	16.25	16.81	15.59	16.00	15.92	16.41	32.33
	Self-Selected	14.87	15.12	13.60	14.80	14.24	14.96	29.20
Verbalize	Think Picture	16.00	15.88	14.11	14.76	15.06	15.32	30.38
	Think Word	16.67	16.28	16.27	1.613	16.47	16.21	32.68
	Self-Selected	14.44	14.38	15.27	15.73	14.86	15.06	29.92
	Totals	15.80	15.75	14.95	15.50	15.38	15.63	31.01

Totals for Main Effects:

Reading Level: High = 31.55; Low = 30.99

Reported Memory Strategy: Imagize = 31.01; Verbalize = 30.84

Induced Memory Strategy: Think Picture = 30.95; Think Word = 32.51; Self-Selected = 29.56

Test Mode: Pictures = 15.38; Word = 15.63

TABLE 2

Source Table for Univariate ANOVA for Words and Picutes

Source of Variance		df	ms	Univariate F	P	Multivariate F	P
Reported Memory Strategy (RMS)	w	1	1.72	.17	.67	.45	.64
	p	1	1.45	.17	.67		
Induced Memory Strategy (IMS)	w	2	27.35	2.83	.06	2.65	.05
	p	2	43.81	5.24	.01		
Reading Level (RL)	w	1	2.98	.31	.58	2.47	.09
	p	1	35.10	4.20	.05		
RMS X IMS	w	2	1.27	.13	.88	.58	.68
	p	2	8.23	.98	.38		
RMS X RL	w	1	3.67	.38	.54	.39	.68
	p	1	6.40	.76	.38		
IMS X RL	w	2	7.26	.75	.47	.88	.48
	p	2	11.16	1.33	.27		
RMS X IMS X RL	w	2	5.66	.58	.56	.46	.77
	p	2	5.87	.70	.50		
Within Subject (Error)	w	184	9.68				
	p	184	8.36				

TABLE 3

Mean Scores by Number of Codes and Test Mode

ONE CODE	PICTURE	WORD	TOTAL	TWO CODES	PICTURE	WORD	TOTAL
Imagizers: See Word -				Imagizers: See Word -			
Think Word	15.92	16.41	32.22	Think Picture	15.71	15.79	31.50
Verbalizers: See Word -				Verbalizers: See Word -			
Think Word	16.47	16.21	32.68	Think Picture	15.06	15.32	30.38
TOTALS	16.20	16.31	32.51	TOTALS	15.39	15.56	30.94